'quality of business': metrics for the Internet age

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what is quality of business

- QoS: quality of service

- QoE: quality of experience:

  - customer perceived

- QoBiz: quality of business

  - business interest

  - dollars…

what is quality of business?

Understanding and measuring the impact of IT resources on the day to day business

IT Metrics

Business Metrics

- How is the health of the business process impacting your business?
- If we provide higher availability and performance around a critical business process, how much additional revenue can we generate?
- What are the cost savings associated with a decrease in process time from order placement to order shipment?
- If we could improve the response time of the web site, would we increase sales?
- Can we tune our interactions with our suppliers to reduce supply chain costs?

QoS

system
- availability
- reliability
- queue length
- processing capacity
- bandwidth
- error rate
- throughput capacity
- headroom
- memory capacity

task
- up at arrival
- successful completion probability
- waiting time
- response time
- achievable throughput
- memory used for task

QoE
- successful download completion probability
- end-to-end response time
- perceived speed of download
- customer friendly site

QoBiz
- cost of transactions lost
- dollars per transaction
- cost of servers
- revenue of web site
- revenue per page
- visiting robots costs

QoBiz: why?

why, and why HP:

- 'quality' can (in theory) always be translated into 'dollars'

- dollars is what matters to HP's customers

- most money for services and solutions is in 'business consulting'

- HP needs technologies that easily translate to fulfilling a business need

QoBiz: why now?

Why QoBiz now:

1. Integration of the user in Internet ecosystems (B2C)

2. Integration of enterprise business processes in web-service ecosystems (B2B)

3. Emergence of the service utility model (service providers/xSPs)

the QoBiz challenge

be able to control the operation of a service-provider
with complete transparency of the underlying infrastructure technology
with proven higher profits and/or lower costs for the service providers

note: service provider can be application service provider, internet data center provider, etc., and combinations thereof

an incarnation of the solution: "executive cockpit"
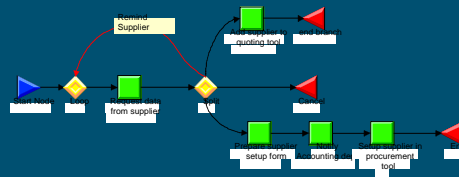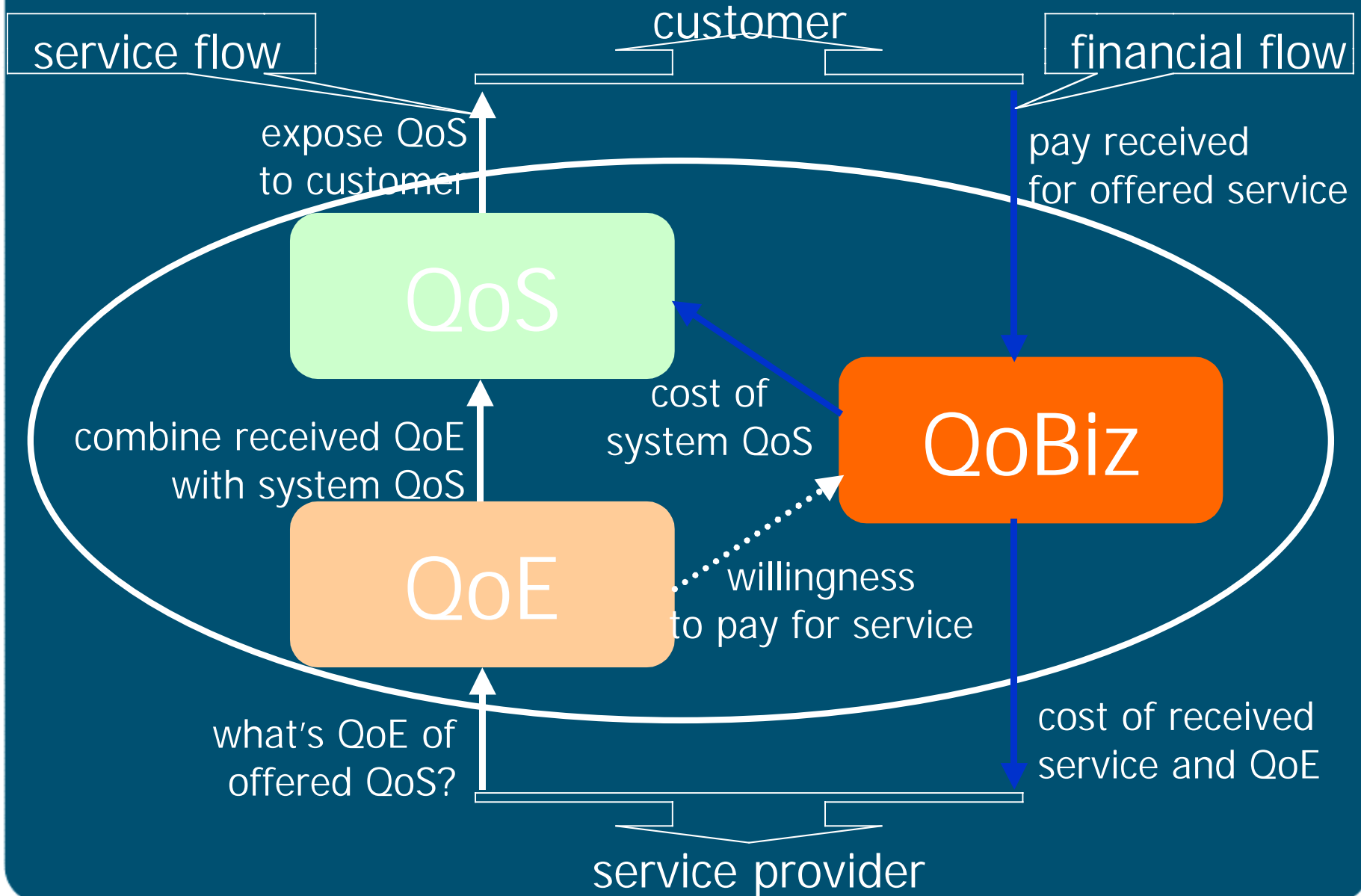
Monitoring

Analysis
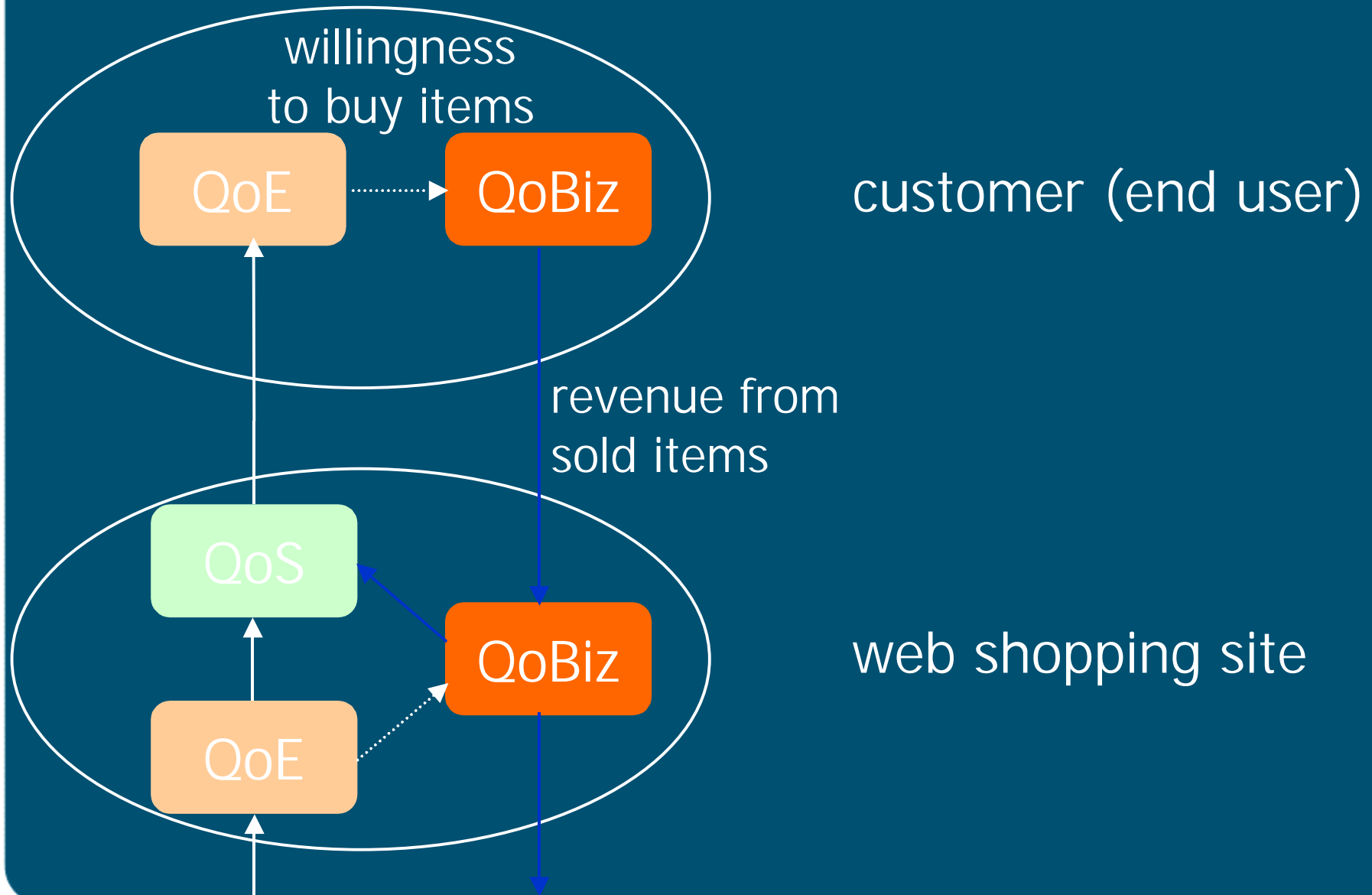
Prediction

Management

(Re)design

what we do at HP Labs

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- business processes

- service-centric computing
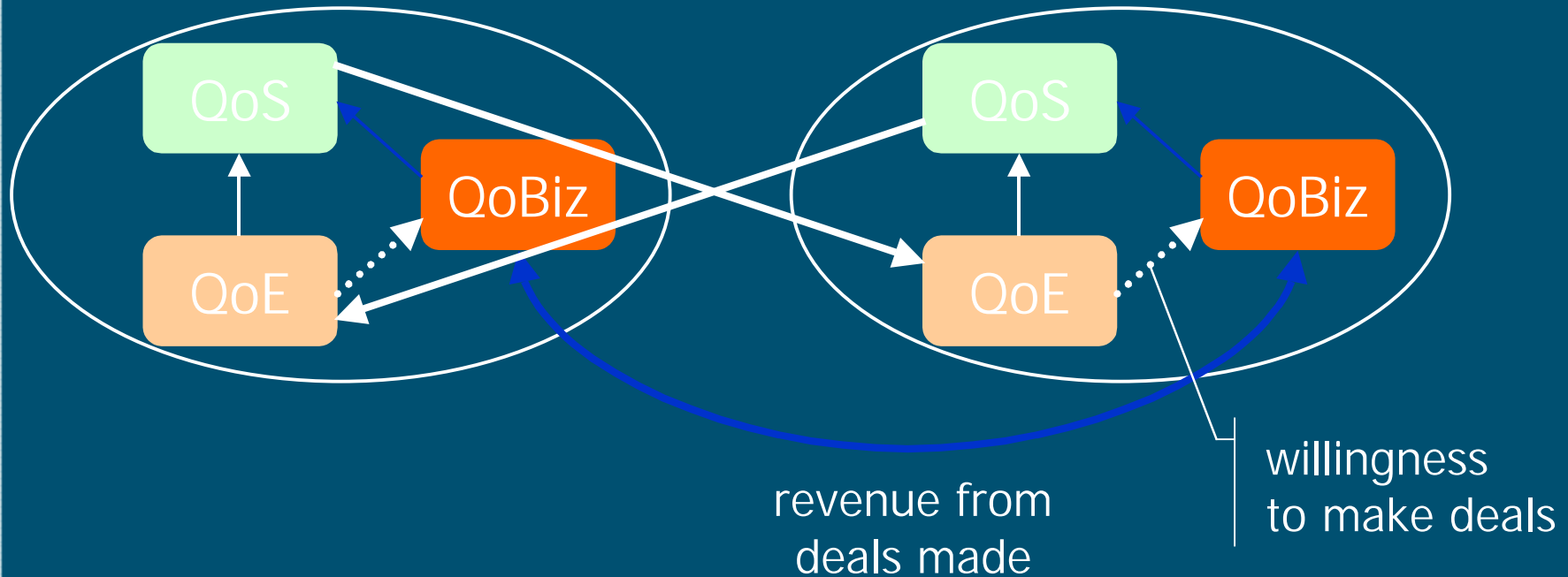
quality metrics for a single party

service flow

customer

financial flow

expose QoS
to customer

pay received
for offered service

QoS

combine received QoE
with system QoS

cost of
system QoS

QoBiz

QoE

willingness
to pay for service

what's QoE of
offered QoS?

cost of received
service and QoE

service provider

quality metrics for B2C scenario

willingness
to buy items

QoE ┄┄▶ QoBiz

customer (end user)

revenue from
sold items

QoS

QoBiz

web shopping site

QoE

quality metrics for B2B scenario

B2B webservice   B2B partner webservice

QoS   QoBiz   QoE

QoS   QoBiz   QoE

revenue from deals made

willingness to make deals

quality metrics for chains of service providers

QoS

QoBiz

QoE

Application Service Provider

SLA

QoS

QoBiz

QoE
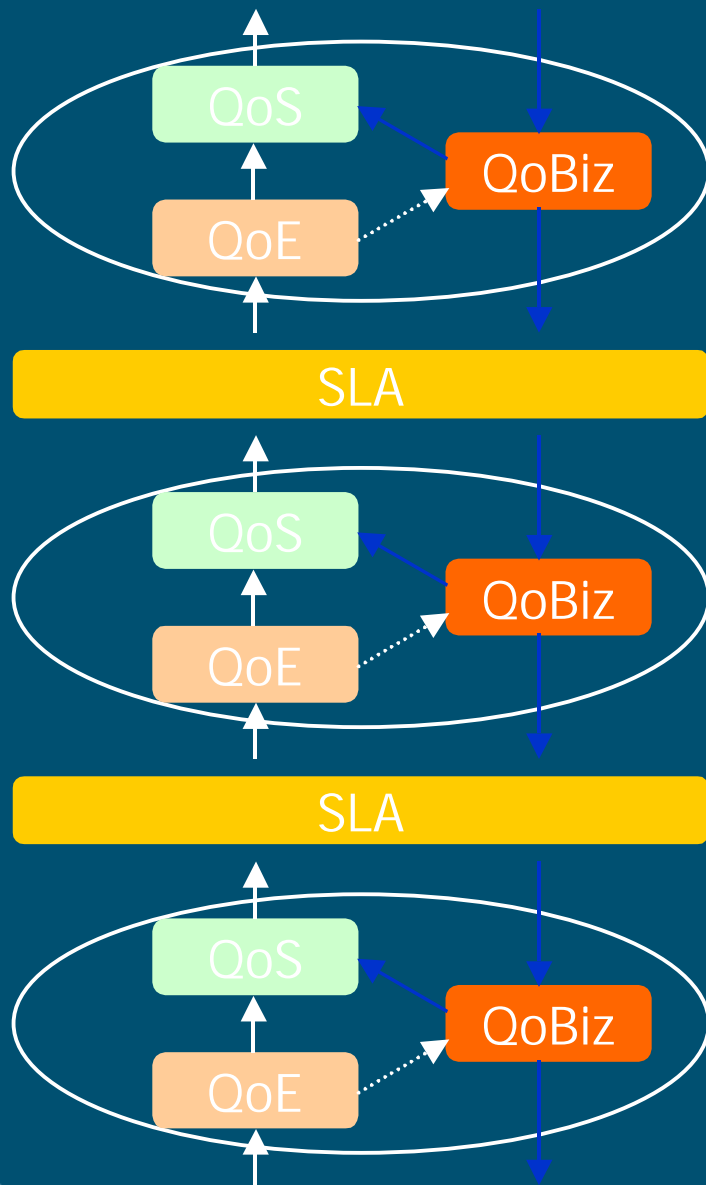
Hosting Service Provider

SLA

QoS

QoBiz

QoE

Internet Service Provider

what we do at HP Labs

- a theory of metrics

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Research Motivation

- HP has novel instrumentation for WWW transactions:

  - End-user perceived response times (Quality of Experience, QoE)

  - Breakdown of transaction residence times

  - WTO, WebMon

- *Does this enable fundamentally new ways of analysis and optimization? Can we correlate response times with resource consumption?*
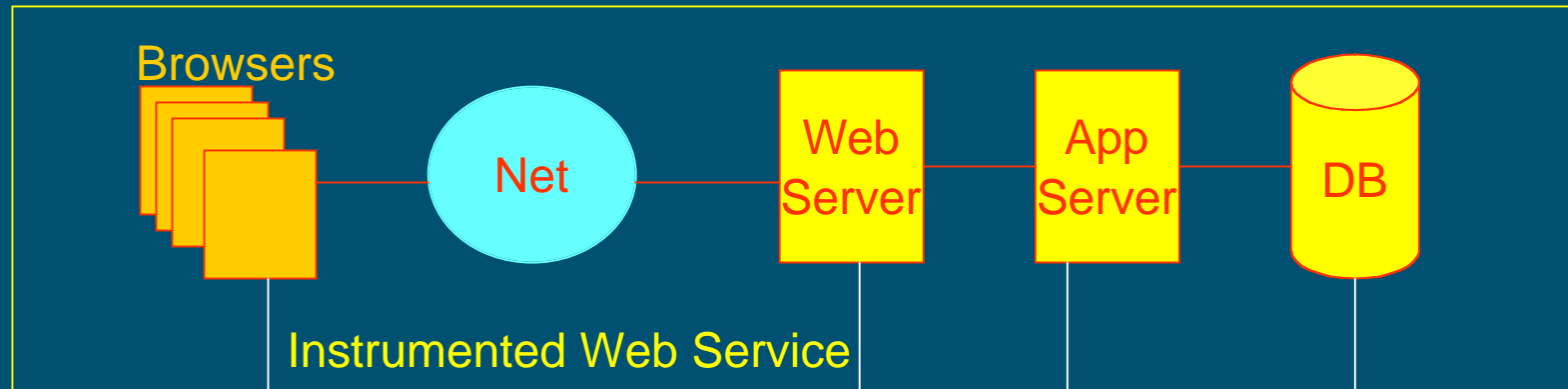
Commercial Motivation

- ## WWW QoE is important for QoBiz!

  - ### Improve QoE and QoBiz

    - Optimization of Web services
    - User behavior analysis
    - usage-based billing
  - competition is "one click away"

  - corporate image at stake

  - large sums of money involved (est. 4.3B/year loss from bad response times, Zona Research, 1999)

- *Novel analysis and optimizations will create and capture new markets for OVBU and Bluestone*

Huge HP Opportunity

Web Transaction Analysis and Optimization (TAO)

Browsers

Net

Web Server

App Server

DB

Instrumented Web Service

Web Transaction Measurements

Visual Data Mining

Transactional Business Analysis

Transactional Performance Analysis

Business Value Optimization

TAO Research Areas

- instrumentation

- grouping of data for results display

- on-line identification of robots

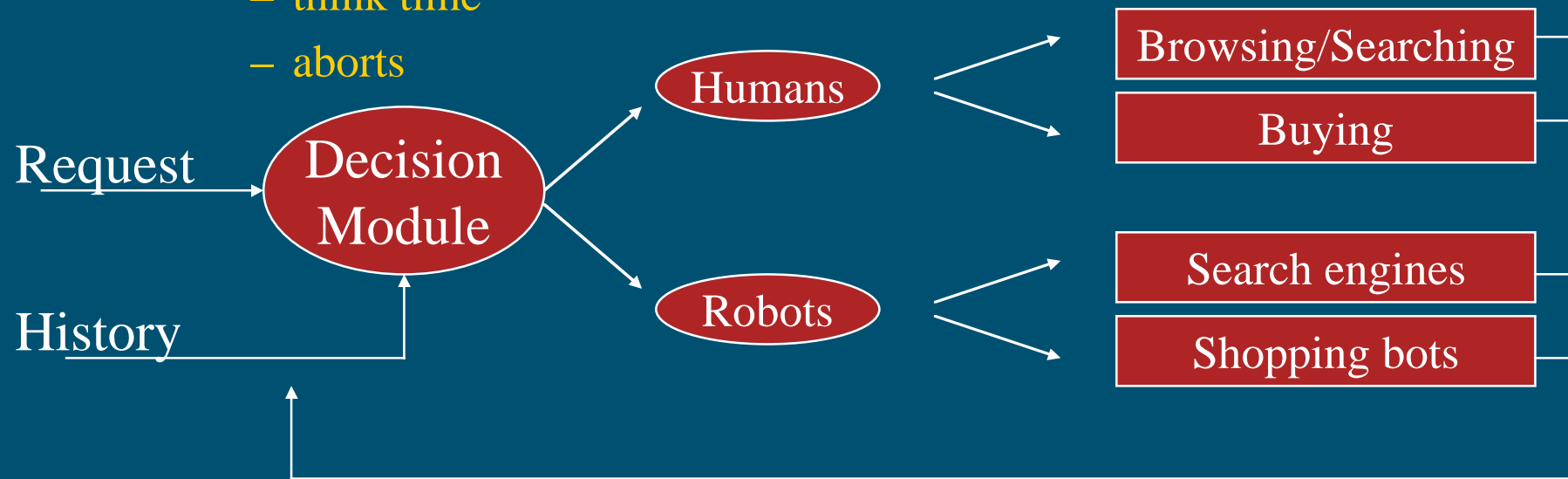- mathematical optimization model for load balancing

EJB/JDBC Instrumentation

- Modify deployment descriptor

    - semi-automatic to preserve XML whitespace formatting

    - automatic, otherwise

- Wrapper functions generated automatically

    - data stored in TLS

    - sent with JSP/Servlet instrumentation

- JDBC Driver instrumentation

    - modify postgres driver source code
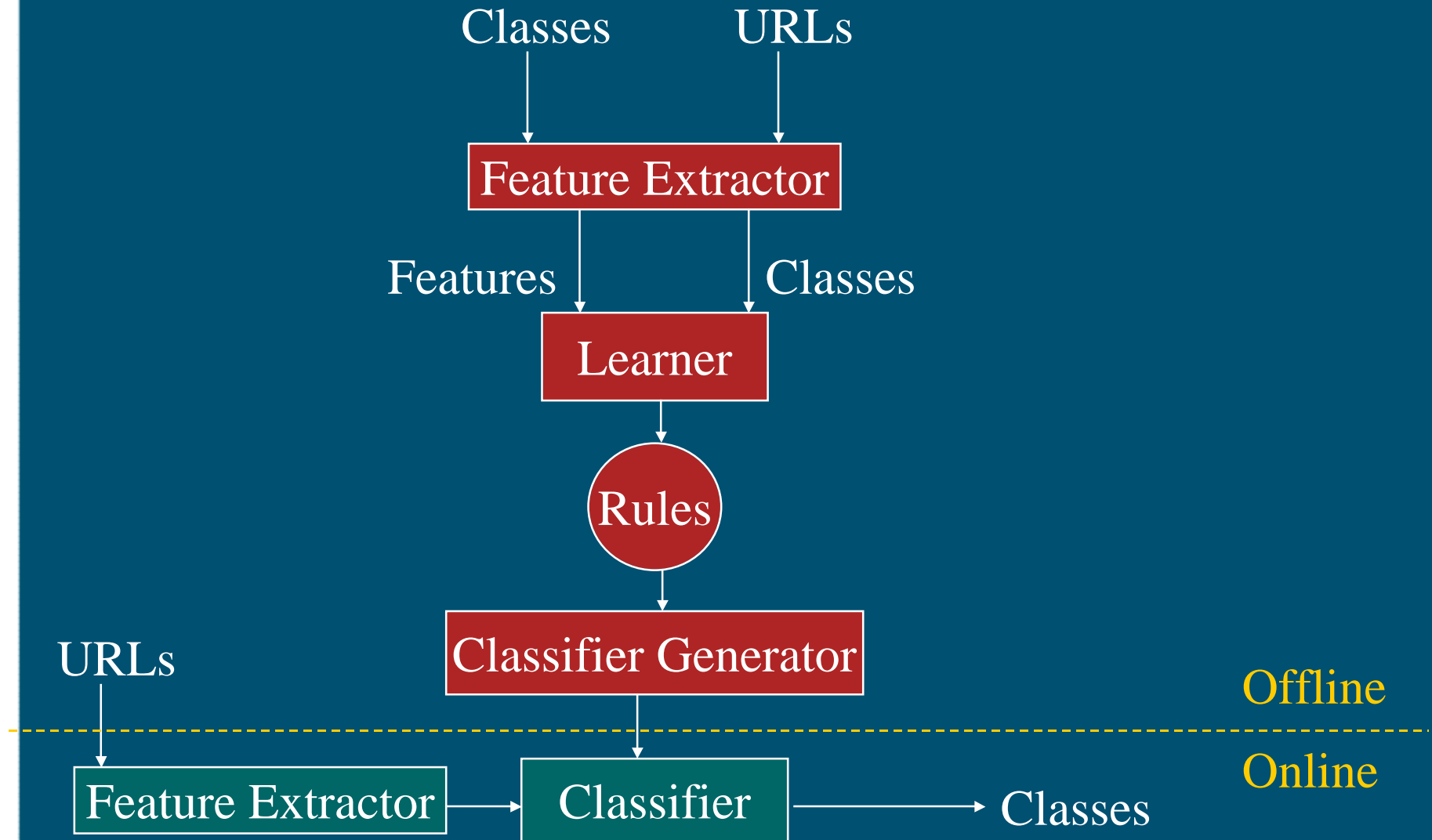
EJB Container

Session Bean
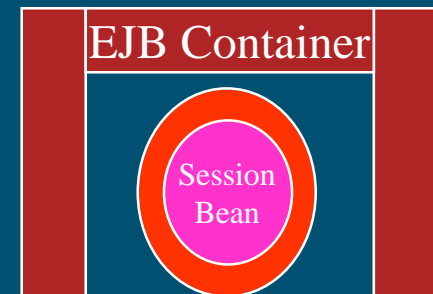
User Segmentation

- Classification of visitors, based on surfing behavior
    - session length
    - distribution of inter-arrival times
    - transaction class
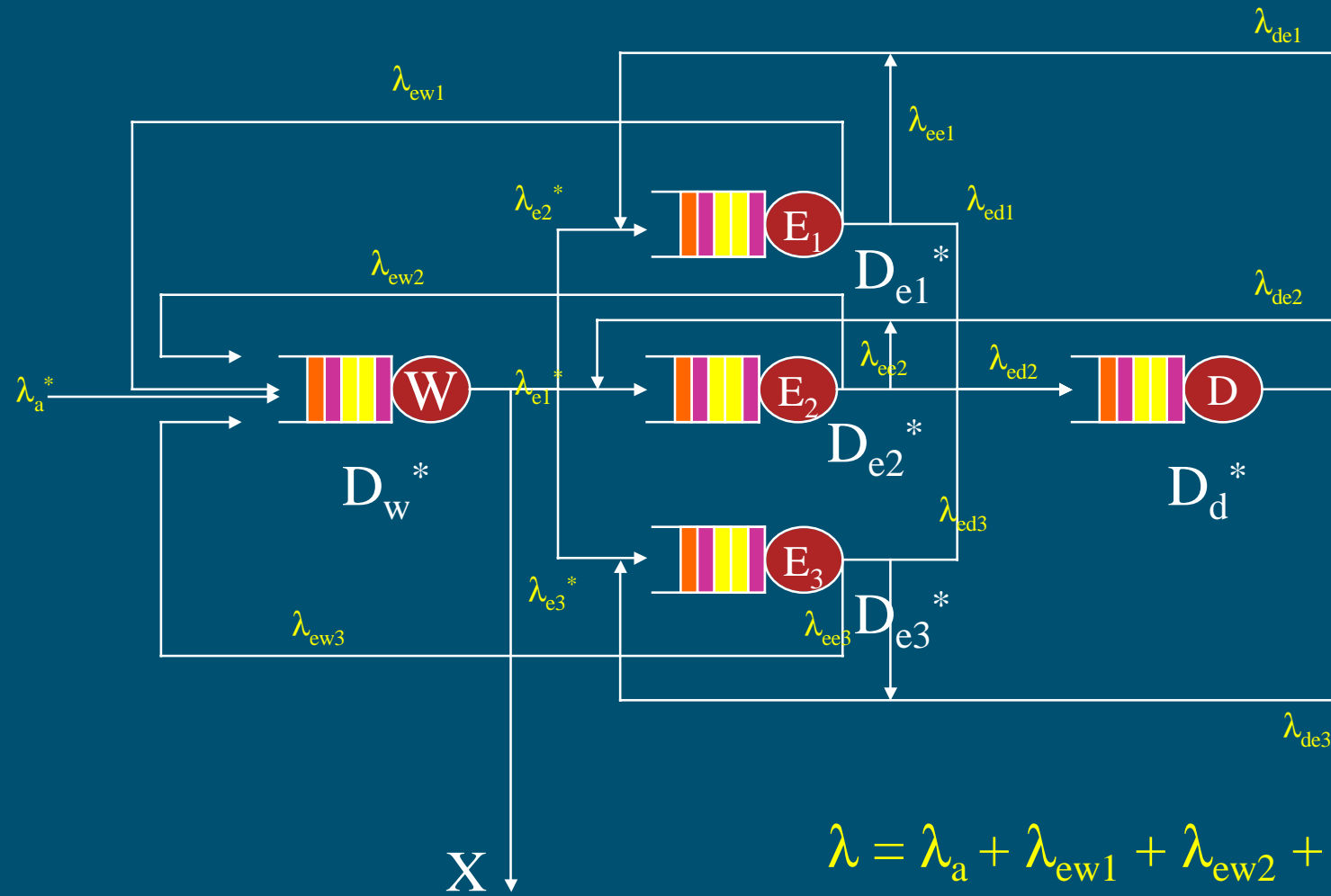   - URL path
    - think time
    - aborts

Request → Decision Module

History

Decision Module → Humans → Browsing/Searching, Buying

Decision Module → Robots → Search engines, Shopping bots

Update Characterization

Transaction Segmentation

Classes   URLs

Feature Extractor

Features   Classes

Learner

Rules

Classifier Generator

URLs

Offline

Online

Feature Extractor → **Classifier** → Classes

J2EE Model

$$\lambda = \lambda_a + \lambda_{ew1} + \lambda_{ew2} + \lambda_{ew3}$$

Integrated Demand and Capacity Planning

- Throttle arrival rate for almost saturated servers

    - load balancing

    - load shedding

- Re-order queues for different classes of transactions

    - transaction classification

    - user segmentation

- Obtain additional servers for saturated servers (with ICPT/ISS)

QoBiz wrap-up

- B2C, B2B and service utility make QoBiz increasingly relevant and tractable

- QoBiz challenge: IT-transparent management that improves the cost/profit -> services, solutions

- HP Labs works on a variety of aspects to meet the QoBiz challenge:
  - metrics framework gives framework for reasoning and directing work
  - e-commerce QoE->QoBiz work is just one example of work in this direction